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POTATO GROWING IN NEW YORK

E. V. HARDENBURG



CULTIVATION IS AN IMPORTANT FACTOR IN PRODUCTION

Where soil moisture is deficient and the soil of heavy type, cultivation every week or ten days is advisable to maintain a surface mulch for moisture conservation. Under moderate rainfall and on light soils less frequent tillage is necessary

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POTATO GROWING IN NEW YORK

E. V. HARDENBURG

The potato as food for human consumption has had a steadily increasing production ever since it was introduced from its native home in the highlands of Peru. Though more people depend on rice as a staple article in the daily ration, potatoes rank first as a world food crop on the basis of actual pounds produced. Probably no other crop furnishes so much actual volume of starchy food for the labor involved in production. The potato is one of the very few plants that owes its great value to the production of enlarged underground stems, known in this case as tubers.

BOTANICAL RELATIONSHIP

Since the potato tuber is really a stem and not a part of the plant root, it may be compared in every way to an aerial stem similar to that of the apple or the peach. Its eye bud corresponds to the bud on an apple twig, while the brow, or ridge, of the eye corresponds to the leaf scar of the twig. In internal structure, a similar comparison may be drawn. Both longitudinal and cross sections of a potato tuber and of a normal aerial stem are shown in figure 67. In cross section a potato consists roughly of two parts, the cortical layer, or outer portion, and the medullary, or inner, area. By close observation on holding a cross section to the light, it may be noted that the medullary, or inner, portion is differentiated into an inner less dense portion and an outer portion richer in starch. This innermost part corresponds to the pith, while the outer medullary part corresponds to the woody portion of an aerial stem. The cortical layer surrounding the medullary part corresponds roughly to the bark of a stem. This cortical layer contains a high concentration of the food elements of

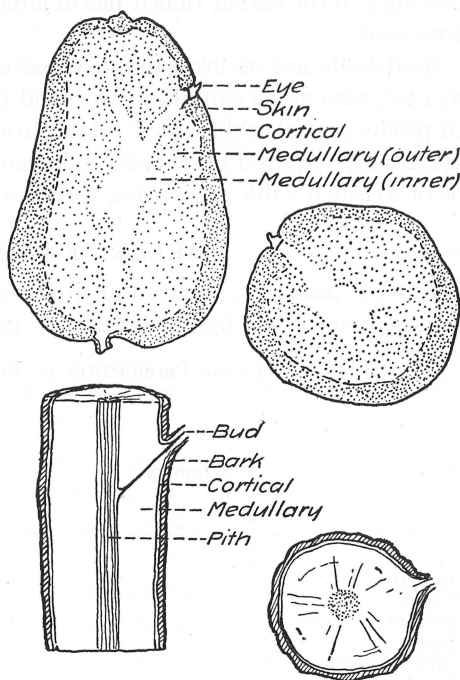


FIG. 67. LONGITUDINAL AND CROSS SECTIONS OF A POTATO TUBER AND OF A NORMAL AERIAL STEM

the potato, including protein, starch, ash, and fiber. This is why potatoes should be pared thinly to avoid needless waste of the most valuable portion.

The potato is the most important of a large group of crop plants belonging to the botanical family known as Solanaceæ. Close relatives, the flowers and often the foliage of which closely resemble that of the potato, are tomato, eggplant, henbane, belladonna, and nightshade. Most of these plants are propagated by means of true seed, the result of cross-pollination. The seed is borne in pulpy fruits of various shapes and sizes, often containing from one hundred to three hundred kidney-shaped seeds. This in fact is the nature of true seed of the potato, the fruit of which is popularly known as potato seed balls. Seed balls are not found in abundance as was once the case, and it is now the exception rather than the rule to find them in any field of growing potatoes. The scarcity is probably due to such factors as failure of the pollen to ripen, sterility of the pollen grains, or propagation of this plant by tubers, or vegetative cuttings, to the extent that it has in large measure lost its ability to develop true seed.

Seed balls are of little or no value except in the hands of the experimenter, who alone can afford to spend the large amount of time necessary to produce marketable-sized tubers from them. From two to four years are usually required to do this, and even then the product derived may not be of so much value as existing varieties or strains.

AREAS OF PRODUCTION

Europe produces about four-fifths of the potato crop of the world, as is shown by the figures on annual production in table 1.

TABLE 1. AVERAGE PRODUCTION IN BUSHELS BY COUNTRIES (1909-1913)

Country	Production in bushels	Average yield per acre (bushels)
Germany.....	1,681,959,000	201
Russia.....	1,252,364,000	106
Austria-Hungary.....	662,202,000	131
France.....	484,960,000	130
United States.....	356,627,000	96
World.....	5,487,326,000	

In spite of this enormous production in so few of the countries of the world, these countries consume nearly all of the crop at home. This is especially true of the United States. Whereas this country exports annually

only 1,044,000 bushels, the imports amount to 2,103,000 bushels, leaving a net consumption of 1,059,000 bushels more than are produced. These figures are the average for the last twenty years. The foreign trade of the United States in potatoes is therefore relatively small.

In the United States the potato crop ranks sixth in acreage with corn, wheat, oats, cotton, and barley, fourth in production with corn, oats, and wheat, and fifth in value with corn, cotton, wheat, and oats, in the order named. Production is largely centered in the States bordering the Great Lakes, probably due to the moderately cool climate of these States. Though Maine does not border the Great Lakes, her rank is fourth in production, due to the cool summers of that latitude and to the extra heavy yields obtained in the single county of Aroostook. New York has ranked first as a potato State for many years, though recently Michigan, Wisconsin, and Minnesota have competed closely for first rank in production. The acreage, the production in bushels, and the average yield per acre for the six leading States, as based on the crops of 1910-1914 inclusive, are shown in table 2.

TABLE 2. ACREAGE, PRODUCTION, AND AVERAGE YIELD PER ACRE BY STATES

State	Acreage	Production in bushels	Average yield per acre (bushels)
New York.....	380,000	33,442,000	88
Michigan.....	345,800	36,118,000	104
Wisconsin.....	286,000	32,390,000	113
Pennsylvania.....	277,600	24,725,000	89
Minnesota.....	236,000	26,009,000	110
Maine.....	124,000	26,861,000	216
United States.....	3,659,400	357,928,200	98

Though potatoes are grown more or less in all sections of New York State, production is distributed roughly in four principal sections, namely: (1) western New York, comprising all that portion of the State directly south of the western end of Lake Ontario and bordering Lake Erie; (2) Franklin and Clinton Counties; (3) upper Hudson River Valley, mainly Washington and Rensselaer Counties; (4) Long Island. The twenty-one counties of the State that produce annually over a million bushels, are shown in figure 68.

According to the United States Census of 1910, more bushels of potatoes are produced annually in New York State than of any other single crop, and with the possible exception of apples, potatoes, as a crop, rank first in total value.

CLIMATE AND SOIL

Potatoes require a cool, moist summer climate. Regions in which the summer temperature sometimes rises to 85° F. or above for very many successive days are not adapted to maximum yields. The high yields obtained under the equable, cool climates of Scotland and northern Germany are largely due to this factor.

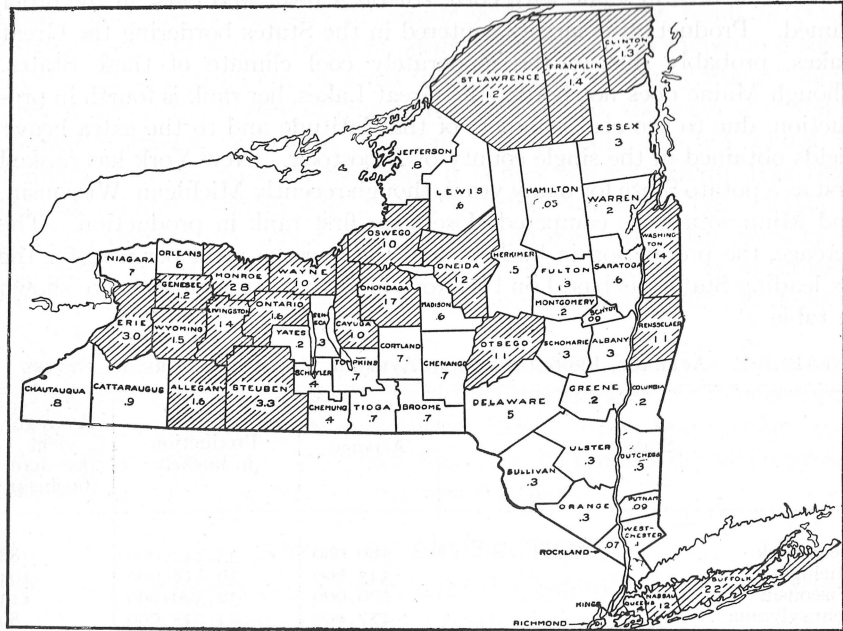


FIG. 68. WHERE THE POTATO CROP OF NEW YORK IS GROWN
The figures are taken from the 1910 Census of the United States and represent millions of bushels. The shaded counties produce at least a million bushels annually

The relation between average growing-season temperature for June, July, and August, and yield per acre in New York, Maine, and Scotland is given in table 3. This indicates the advantage of the cooler climates of Maine and Scotland over that of New York.

TABLE 3. RELATION OF MEAN TEMPERATURE FOR JUNE, JULY, AND AUGUST, TO YIELD IN 1909

Region	June (degrees Fahrenheit)	July (degrees Fahrenheit)	August (degrees Fahrenheit)	Yield per acre (bushels)
New York.....	65.0	70.0	67.0	123
Maine.....	61.9	66.9	65.0	210
Scotland.....	55.0	58.0	58.0	350

Rainfall and length of growing season are seldom limiting factors to production in this State. The principal potato sections are located in areas subject to both minimum and maximum rainfall during the growing season and in which the growing season varies from one hundred and fifty to two hundred days (Table 4).

TABLE 4. LENGTH OF GROWING SEASON AND AMOUNT OF RAINFALL DURING GROWING SEASON IN PRINCIPAL POTATO SECTIONS OF NEW YORK

Region	Average date of last frost in spring	Average date of first frost in fall	Number of days in growing season	Rainfall during growing season (inches)
Steuben County.....	May 10	Oct. 5	150	16-18
Monroe County.....	May 1	Oct. 15	165	14-16
Washington County.....	May 5-10	Oct. 1	150	16-18
Franklin and Clinton Counties.....	May 10	Oct. 1-10	150	14-18
Suffolk County.....	April 25	Oct. 1-25	200	16-20

Soil type is probably of less importance than climate, since fair yields are produced on all but the very heaviest types of soil in many parts of the United States. The ideal potato soil is a light, workable loam of medium texture, relatively rich in humus. Light soils are better than heavy because they are more conducive to (1) disease control, (2) ease in planting and harvesting, (3) well-shaped and uniform tubers, (4) good quality, and (5) early maturity.

ROTATIONS AND FERTILIZERS

The large variety of crops produced makes it difficult to define the most common place that the potato crop occupies in the rotation. Where corn is grown, potatoes usually follow it, the corn being given the advantages of a turned sod. This allows the corn as a coarse feeder to make use of the top-dressing of stable manure applied to timothy sod just before plowing and allows the potato crop to make use of the residual manure in a more finely divided form. Also a better tilth of seed bed is obtained for potatoes in this way. Where lime is needed to correct soil acidity, it may be applied directly after the potato crop, and the organism causing potato scab, ordinarily favored by the resulting alkaline soil, will not seriously affect the succeeding potato crop on account of the intervening crops in the rotation. Lime so applied will also benefit the clover seeding that usually accompanies oats or wheat following potatoes. In sections where the white grub has proved disastrous to the potato crop, this practice

of growing a cultivated crop, such as corn, between sod and potatoes will tend to eliminate this insect. The principle applies equally well to the control of wireworms. Fall plowing, exposing the larvæ of both of these beetles to the action of winter freezing and thawing, will also assist in their control.

Owing to the desirable form of organic nitrogen furnished in clover sod, an ideal three-years rotation consists of clover, potatoes, and oats or wheat. In order to counterbalance the heavy demands on soil fertility caused by the frequency of potatoes in so short a rotation, commercial fertilizers and lime if needed should be applied with the grain crop and the stable manure on the sod. This keeps the lime farthest from the potato crop and benefits the clover. In sections, like Long Island, where successive crops are grown on the same land, large amounts of fertilizer are necessary to maintain yields. Rye is often used as a fall-seeded green-manure crop to furnish the humus needed. Investigations in southern New York show that the quality and the density of timothy sod plowed before potato planting are important factors influencing yield. Heavy types of land to be devoted to potato growing are improved greatly by proper drainage and liming. The taproot system of buckwheat makes this crop of much value in breaking up new land where the subsoil is inclined to be hard.

Under normal conditions, complete fertilizers, analyzing relatively high in potash and phosphoric acid, are recommended, since the potato plant draws heaviest on these elements. The most common analysis used in New York is probably 2-8-10. Sandy soils devoted to potato culture are usually lower in potash content than those of heavier type. For this reason, growers until recently have used larger amounts of potash in commercial fertilizers on Long Island than in other sections of New York. More than fifteen hundred pounds per acre of such fertilizer has not been considered profitable. Less potash is now being recommended and used than formerly. At times like the present, when the supply of German potash is cut off, commercial forms of potash cannot profitably be used. Such practices as will make more available the potash already in the soil should be observed. These may be enumerated as liming, thorough tillage, and the addition of such organic manures as are available. Complete fertilizers for most of the heavier soils of New York probably should analyze higher in phosphoric acid than in potash. This, however, is a factor to be determined by test in the locality concerned. Nitrogen in fertilizer tends to increase foliage production and to prolong growth; phosphoric acid in addition to increasing yield hastens maturity; and potash increases yield and improves quality. On the average potato soil, one-half the nitrogen should be applied in some slowly available

form, such as ammonium sulfate, the other half in a more quickly available form, such as nitrate of soda. The phosphoric acid is most commonly applied as acid phosphate. The two common sources of potash are sulfate and muriate, or chloride, of potash. Though the muriate is usually cheaper and more commonly used than the sulfate either alone or in complete fertilizer, the chlorine contained in it is thought to be somewhat detrimental to quality.

Wherever machine planters are used, the fertilizer is usually applied from a hopper just in front of the seed. In this way it becomes mixed with the soil, and there is little danger of burning the seed. Where no planter is used, it is either drilled, just before or just after planting, with a grain drill or lime sower or strung by hand in the open furrow ahead of planting. In the latter case care should be used to avoid direct contact of seed and fertilizer on account of injury to the seed.

SEED

It is common knowledge that potatoes tend to lose vitality, or "run out," under the influence of hot summer climate, warm storage conditions, or excessively dry soils. This often necessitates a renewal of seed. Southern growers find it necessary to buy northern grown seed every year on this account. Growers in New York need not renew seed so often, though an occasional renewal of vigor from seed grown in northern New York or Maine is sometimes desirable. Indications of degeneracy in a variety are the tendency of the tubers to become pointed at the ends or spindle-shaped, failure to come up uniformly, decreasing yield, and failure to develop vigorous dark green tops.

Most seed is not given sufficient care in storage. It should be stored under moderately dry, cool, well-ventilated conditions. A temperature of 32° to 40° F. is best in order to maintain the dormancy of the tubers. A storage too warm tends to hasten the ripening process and promotes early sprout development. These sprouts when removed weaken the vigor of the seed, and those which develop later are not so good. Too much moisture in storage encourages the development and spread of late blight and bacterial rots.

It is desirable to bring seed into subdued sunlight about two weeks before planting time in order to develop short green rugged sprouts. This practice known as "sprouting," or "greening," facilitates a saving of time when an early crop is desired and the soil is yet too wet and cold for immediate planting. It also gives an opportunity to cull out diseased and dormant tubers. The sprouts should not be allowed to become more than a half inch long as they are otherwise likely to be knocked off in planting.

If the seed is affected with either scab or rhizoctonia disease, it should be chemically treated before "sprouting" or cutting is done, otherwise injury may result to the sprouts. If both diseases are present, corrosive sublimate (mercuric bichloride) should be used, as this is effective in the control of both. If scab alone is present, formalin (40 per cent formaldehyde) is sufficient. Formalin is not effective in the control of rhizoctonia.

Corrosive sublimate is used at a strength of 4 ounces to 30 gallons of water, and the uncut seed is immersed in this solution for one and one-half hours. This is a deadly poison and should not be left exposed to livestock or children. In contrast to formalin, it loses strength rapidly with use, and the same solution should not be used more than three times.

Formalin is used at a strength of 1 pint to 30 gallons of water, and the seed is immersed for two hours. Care should be observed in buying to insure getting the standard 40-per-cent strength, since old formalin or that sold by unscrupulous druggists may be weaker and hence not effective.

Seed may be treated at any time during the dormant period, but the storage bags or barrels should be treated with formalin before restoring to avoid further contamination. All treated seed should be well dried before storing to avoid heating. Seed tubers should not be cut more than two days previous to planting, since cut seed decreases in vitality due to bleeding and drying if left longer than this. Much of the seed used in this State is cut on either the day before or the day it is planted. On account of large acreages and much labor in cutting, many growers on Long Island who buy their seed from Maine or upper New York in large quantities, find it advisable to cut seed a week or more ahead of planting. The drying and bleeding of seed in this case is lessened by dusting the cut surface with land plaster, or gypsum. Land plaster is adhesive and does not injure the cut seed. It is probably not profitable nor necessary to dust cut seed except where it is to be stored more than three or four days after cutting. Such seed should be spread thinly to avoid heating during storage.

One vigorous eye on each seed piece is sufficient. Where seed is not especially vigorous, it is safer to leave two or more eyes in order to insure germination. Size of seed piece is much more important than number of eyes. Pieces weighing less than two ounces, or that are smaller than a hen's egg, are usually not desirable. Since the eyes at the bud, or "seed," end of the tuber are more vigorous than those at the stem end, it is never advisable to discard that end because of any likelihood of small potatoes forming as a result of such pieces. "Seed" end pieces may result in more culls if planted with the entire bud cluster, but this can be avoided by cutting the tuber from end to end. The stem end pieces may be made of equal value to those from the seed end by cutting them larger, in order to counterbalance their less vigorous eyes.

It is advisable to cut seed when it is of large type, relatively expensive, and when labor is cheap. Cutting is an important labor item, since the cutting of twenty bushels is an average day's work. Machine cutters are quicker, but, since they do not permit of sufficient care in cutting, they are probably not practicable. Small potatoes should not be used for seed unless seed is very expensive and it is known that they come from good yielding hills. In using small seed selected from the storage bin, chances more than favor its having come from degenerate hills. For information on the breeding of potatoes the reader is referred to Cornell Reading Course Lesson 68 (1914), *Improving the Potato Crop by Selection*.

In general, yield is directly proportional to the size of seed piece used. The investigations of most experiment stations show that yield is profitably increased up to and including half tubers, and that as a rule the yield from whole potatoes does not warrant the extra expense of seed.

Similarly, yield is directly proportional to the number of bushels planted per acre up to 20 bushels. Most growers plant too little seed, the average for the State being about 12 bushels. An average of about 10 bushels is planted in Steuben County, while Long Island growers plant an average of 12.5 bushels. The relation of amount of seed per acre to yield on 360 farms in Steuben County is shown in table 5.

TABLE 5. RELATION OF AMOUNT OF SEED PLANTED TO YIELD ON 360 FARMS IN STEUBEN COUNTY

Number of farms	Amount of seed planted per acre (bushels)	Average yield per acre (bushels)
19.....	6- 8	117.8
138.....	8-10	123.1
126.....	10-12	138.3
57.....	12-14	147.7
15.....	14-16	176.3
5.....	16-18	224.8
360.....	10.1	136.4

PLANTING

The average date of planting for most sections of New York, outside of Long Island, is about June first. The best time to plant, however, depends on local conditions, such as fitness of the seed bed and average date of last killing frost in the spring. Potato growers on Long Island plant as early as April 10 to April 25 on account of an early season and a light sandy soil. Nassau County growers take advantage of this practice in order to put

their crop of early varieties on the New York markets before other sections of the State find it possible.

Potato seed is likely to rot before germinating on account of cold wet soil if planted too early. Usually the crop may be planted somewhat earlier on the lighter soils and at the lower elevations. The earliest date at which potatoes can be planted with safety in most sections of the State is indicated in table 4, which gives the average date of the last killing frost in the spring. It is usually best to plant at a time that will allow the period of tuber formation to come during the cool part of the growing season. For much of the State, the crop may be planted as late as June 1 to 10 to best withstand midsummer heat and drought.

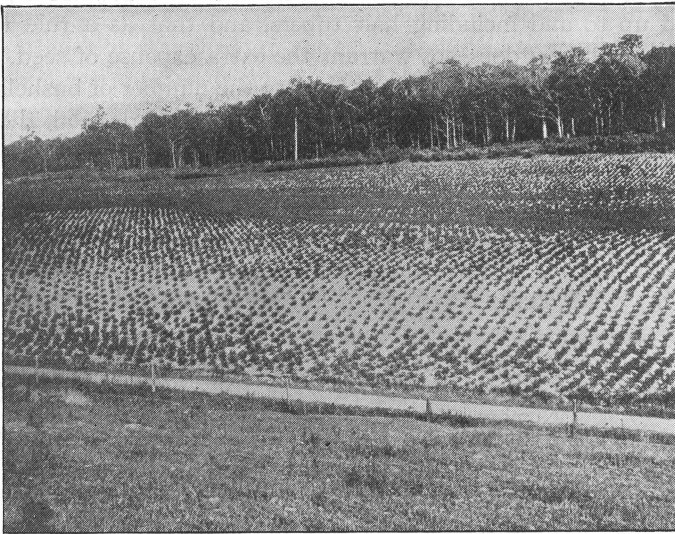


FIG. 69. CHECKROWED POTATO FIELD ON A HILL FARM IN STEUBEN COUNTY

With the exception of some of the hill farms of southern New York most of the crop of the State is planted in continuous drill rows rather than in checkrows. Experiments and actual farm practice show that the yield is considerably better where the former method is used. Though more seed per acre is used in drill planting, the extra yield resulting makes this method much more profitable on most farms. The principal advantage of planting in checkrows is that it permits of cross cultivation in the control of weeds. In general it is advisable to plant in checkrows only when land is relatively cheap, labor is expensive, and weed control is likely to be an important factor. A checkrowed field of potatoes on a hillside farm in Steuben County is shown in figure 69.

Probably more than half of the acreage in New York State is planted with machines, which are of two types, namely, (1) the one-man, or picker, type; and (2) the two-man, or platform, type. The one-man planter has a vertical rotary set of iron hooks, or pickers, which pick the seed pieces from the containing hopper and carry them down, one at a time, and drop them automatically through the delivery hose. The platform type has a chain-driven carrier, which takes the seed pieces from the hopper to a horizontal platform. As the platform turns, the seed pieces are dropped automatically, one at a time, through a slot into the delivery hose. An extra man is required to sit behind the platform to see to it that single pieces are deposited uniformly. The picker planter usually costs about \$60, while the platform type costs about \$75. It is generally thought that the better stand resulting from the use of the platform type more than pays for the extra labor required and the higher initial cost of the planter.

A recent investigation by the College of Agriculture shows that it is economical to operate a machine planter, rather than to plant by hand, wherever the area of potatoes is at least five acres. Besides this, the advantages of machine planting over hand are (1) more uniform distribution of seed and fertilizer, and (2) quicker covering of the seed to avoid drying out in the open furrow. No extra labor is required for marking the rows where machine planters are used, since these machines mark and plant in one operation. In some sections where the acreages are small and potatoes follow sod, the seed is plowed in at the time of turning the sod, the land being rolled and harrowed immediately afterward. Though there is some saving of labor in this method, it is usually advisable only on loamy soils in which moisture capillarity is readily readjusted.

The best depth at which to plant is that at which the most uniform supply of moisture prevails throughout the growing season. For most soils this is about four inches. Planting should be shallower in heavy soils and deeper in light soils. Potatoes planted too close to the surface are subject to sunburning and are usually of poorer quality than those planted deeper. The principal objections to deep planting are the difficulty in harvesting and the greater susceptibility to rot in heavy soils. Where ridging is practicable, the seed may be planted very shallow and the dirt gradually worked toward the row covering both the seed and the weeds as the season advances. This is the system in common use in Maine where labor is relatively scarce except at harvest time.

CULTIVATION

Like most other cultivated crops, potatoes require clean cultivation, the frequency being determined largely by soil types, available moisture, and condition of seed bed. Thorough tillage is more important during early

growth than later. An implement somewhat resembling a horse rake and known as a weeder is commonly used on Long Island and to a limited extent in other sections of New York, to keep down newly germinated weeds. The weeder is used frequently without damage to the growing tops, until the plants have reached a height of from five to six inches. Where soil moisture is deficient and the soil of heavy type, cultivation every week or ten days is advisable to maintain a surface mulch for moisture conservation. Under moderate rainfall and on light soils, less frequent tillage is necessary.

There are two general systems of culture in practice, namely, level and ridge. The former is thought to give somewhat higher yields and is used rather generally throughout Long Island and to some extent in the counties directly south of Lake Ontario. The latter system, however, is adapted



FIG. 70. A POTATO HILLER IN OPERATION IN SOUTHERN NEW YORK

to most regions of relatively high rainfall and to the heavier soils. The advantages claimed for ridge culture are (1) better surface evaporation for heavy soils subject to excess moisture, (2) easier weed control by covering, and (3) easier digging. A hiller, the implement generally used for ridging, is shown in figure 70 in operation.

Late season cultivation should not be deeper than from two to three inches in order to avoid disturbance of the feeding roots, which develop close to the surface at this time.

DISEASES AND SPRAYING

Potatoes are subject to numerous fungus, bacterial, and physiological diseases many of which are prevalent in New York State. These may be classified under three headings according to their scope of attack as (1) those

affecting the foliage only, (2) those affecting the tubers chiefly, and (3) those affecting both foliage and tubers. The most important of these are listed here:

- (1) Affecting foliage only
 - Early blight (*Alternaria solani*)
 - Tip burn
- (2) Affecting tubers chiefly
 - Common scab (*Actinomyces chromogenus*)
 - Powdery scab (*Spongospora subterranea*)
 - Wart disease (*Chrysophlyctis endobiotica*)
 - Silver scurf (*Spondylocadium atrovirens*)
 - Internal brown spot
- (3) Affecting both foliage and tubers
 - Late blight (*Phytophthora infestans*)
 - Rhizoctoniose (*Corticium vagum*)
 - Black leg (*Bacillus phytophthorus*)
 - Fusarium wilt (*Fusarium oxysporum*)
 - Verticillium wilt (*Verticillium albo-atrum*)
 - Bacterial soft rots (*Bacillus solanacearum*)
 - Curly dwarf
 - Leaf roll
 - Mosaic

Detailed knowledge of the symptoms and the control measures for these diseases is not to be assumed on the part of the average grower. For this the experiment stations or the Department of Plant Pathology of the College of Agriculture should be consulted. However, the following general discussion indicates the relative importance of and control measures for some of these diseases.

Late blight is by far the most severe of all potato diseases. The general epidemic of 1915 is evidence of this fact. Its spread is favored by warm muggy days and an abundance of moisture. The causal organism hibernates within the seed and cannot therefore be controlled except by thorough spraying with bordeaux mixture. Seed free from blight is desirable but may not be necessary in the control of this disease. Spraying should always be done before rains rather than after and should be frequent enough throughout the growing season to insure complete covering of all foliage. Newly developed foliage requires that the vines be sprayed at least every ten days to two weeks. Spraying late in the season is desirable even if vines completely cover the space between rows. The effect of frequency of spraying with bordeaux mixture on yield on 109 farms in Suffolk County in 1912 is given in table 6.

TABLE 6. RELATION OF SPRAYING WITH BORDEAUX MIXTURE TO YIELD ON 109 SUFFOLK COUNTY FARMS IN 1912

Times sprayed	Number of farms	Average yield per acre (bushels)
Less than 3.....	7	185.9
3 to 6.....	43	188.3
6 to 8.....	42	193.9
8 and over.....	17	221.6

Bordeaux mixture is usually made at a strength of five pounds of blue vitriol (copper sulfate) to five pounds of stone lime in fifty gallons of water. Some authorities state that weaker solutions, such as 3-3-50 or 4-4-50, may be used during the early part of the growing season. The mixture owes its fungicidal value to the poisonous effect of the blue vitriol. The lime neutralizes the vitriol to prevent burning of the foliage and makes the mixture adhesive. Stock solutions of lime and copper sulfate should be prepared before the time of spraying. The stock solution of lime is made by slaking a bushel of good stone lime or lump lime in a barrel, using at first only enough water to cause the lumps to crumble into fine pieces. Later more water may be added to make a paste and finally enough water to make fifty gallons of milk of lime. This constitutes a stock solution of one pound of lime to each gallon of water. Hydrated, or slaked, lime may be used instead of stone lime, but ground limestone or air-slaked lime should never be used.

In a similar way a stock solution of copper sulfate is prepared, except that the fifty pounds of sulfate are suspended in the top of the barrel of water. As the crystals dissolve, the substance readily mixes with the water until a stock solution of one pound of copper sulfate to each gallon of water is formed.

In making the mixture, slightly more lime than vitriol should be used to insure that the mixture may not burn the foliage. The use of a few drops of yellow prussiate of potash (potassium ferrocyanide) in a sample of the mixture will test this point. A reddish brown reaction indicates an excess of vitriol and the need of more lime. The stock solutions should be added to the water separately as mixing them previously results in a precipitate, which will clog the nozzles. Thorough agitation of the mixture and high pressure are essentials to successful spraying with bordeaux. Early blight is effectively controlled by this same means. A high-power traction sprayer that will treat seven rows at a time is illustrated in figure 71.

The insecticides used advisedly in combination with bordeaux mixture for the control of the Colorado potato beetle (*Leptinotarsa decemlineata*) and the flea beetle (*Crepidodera cucumeris*) are paris green and arsenate of lead. The former is used at a strength of one pound to fifty gallons of water, the latter at a strength of four pounds to fifty gallons of water.

The organisms causing common scab and rhizoctonia, both of which require chemical seed treatment as previously discussed under seed, also live over in the soil, and therefore crop rotation is required to insure clean soil as a further means of control. The organisms causing diseases, such as the wilts, silver scurf, internal brown spot, black leg, curly dwarf,

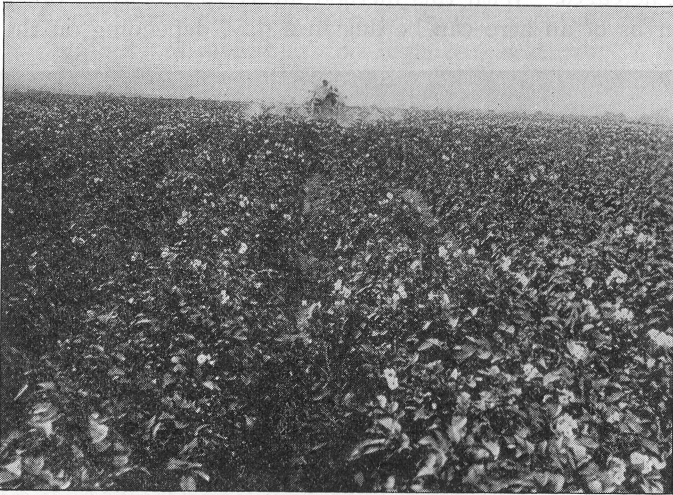


FIG. 71. A SEVEN-ROW TRACTION SPRAYER IN USE ON A LONG ISLAND POTATO FIELD

leaf roll, and mosaic, which are carried over from one season to another with the seed, require the selection of disease-free seed for their effective control. Black leg is also partially controlled by chemical treatment. A wise precaution to be taken in order to avoid such diseases as the wilts, black leg, mosaic, curly dwarf, and leaf roll, and plants showing weak or spindling sprouts is to select seed tubers from healthy plants during the growing season.

HARVESTING

Harvesting for many sections of the State is done at a time convenient to other farm operations. This is due to the common idea that potatoes are not damaged by being left in the soil after maturity. This is true in so far as weather is favorable and the danger of rot and early freezes

not serious. The late crop is usually not dug until the tops are dead, whereas the early crop is often harvested as soon as the tubers are of at least marketable size. This makes it possible to take advantage of early market prices and in the trucking sections to follow the crop by some short season vegetable crop, such as turnips or late cabbage. Potatoes should not be dug from a field badly infected with late blight until all tops are dead, as digging before this would tend to spread the infection to the tubers from diseased vines. For the same reason, potatoes should never be covered in the field with blighted tops to prevent sunburning.

The old method of digging with a spading fork or hook is common on small acreages. With this method an average of from one-fourth to three-fourths of an acre can be dug in a day, depending on the type of

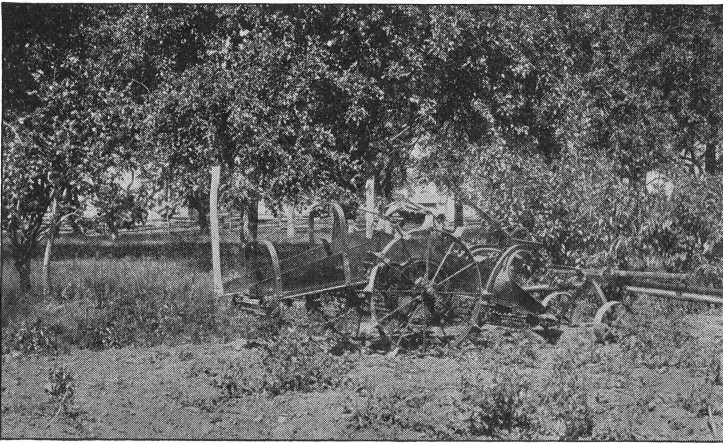


FIG. 72. A MODERN CHAIN ELEVATOR POTATO DIGGER

soil, the yield, and the man digging. Sometimes the crop is plowed out with either a common or a shovel plow. The objection to this is the large amount of tubers covered or never brought to view. It may be advisable on small areas, however, where the soil is heavy and labor for digging expensive. Modern machine diggers of the chain elevator type, costing from \$80 to \$125, are now in general use on most of the large potato farms. These often require extra horses for operation, but an average of five acres can be conveniently dug with them in a day. This type of modern digger is shown in figure 72.

In order to lessen danger from inclement weather, freezing, and sunburning, potatoes are usually picked up immediately after being dug. Square slatted crates of one bushel capacity are most common except in the trucking section of Nassau County, where large splint baskets

are used in hauling directly to market. Such crates are convenient to handle and are desirable for cellar storage since they allow of thorough ventilation when piled in large bulk and easy removal from storage at planting time.

STORAGE, MARKETING, AND GRADING

During the normal storage season and under average storage conditions of 45° to 55° F., potatoes shrink from six to eight per cent from water loss alone. This is a factor to be considered in determining the advisability of storage at all. Long Island growers market practically the entire crop at harvest time, while growers in other sections of the State market a part and store the rest partly in accordance with their storage facilities. As a rule potatoes are stored at too high temperatures. A study of potato prices averaged over a series of years indicates the advisability of marketing at harvest time. This takes into account the extra labor of handling, the risk of loss by disease, shrinkage, or freezing, and the rental of storage. By studying crop reports for information on the probable production for a current year, and assuming the average per capita consumption to be about 3.5 bushels, one can estimate the likelihood of overproduction or crop shortage.

Grading potatoes in New York has had little impetus until recently, and very few are put on the market as graded stock. It is highly probable that more income could be realized from the crop if only standard tubers graded over a one and seven-eighths-inch screen were put on the market and the remainder fed at home. The New York State Potato Association is at present encouraging more grading. This would provide for the elimination of a large amount of diseased and mechanically injured tubers, which now find their way onto most markets, and would result in a more uniform product.

VARIETIES

There is probably no one best variety of potatoes, though in the immense number grown in this State there are some good ones and many poor ones. The variety to be chosen for a given locality should be one selected after inquiry into the prevailing group grown in that region. In many of the counties far too many varieties and types are grown. Those that are concentrating on only a few are the ones who are establishing a reputation. Examples of this are Franklin and Clinton Counties and Suffolk County, Long Island.

Potatoes have been classified¹ into eleven groups, or families, as based mainly on color of sprouts, color of blossoms, shape, size, depth and

¹ Group classification and varietal description of some American potatoes. U. S. Agr. Dept. Bulletin 176.

frequency of eyes, and texture of skin. These groups are (1) Cobbler, (2) Triumph, (3) Early Michigan, (4) Rose, (5) Early Ohio, (6) Hebron,

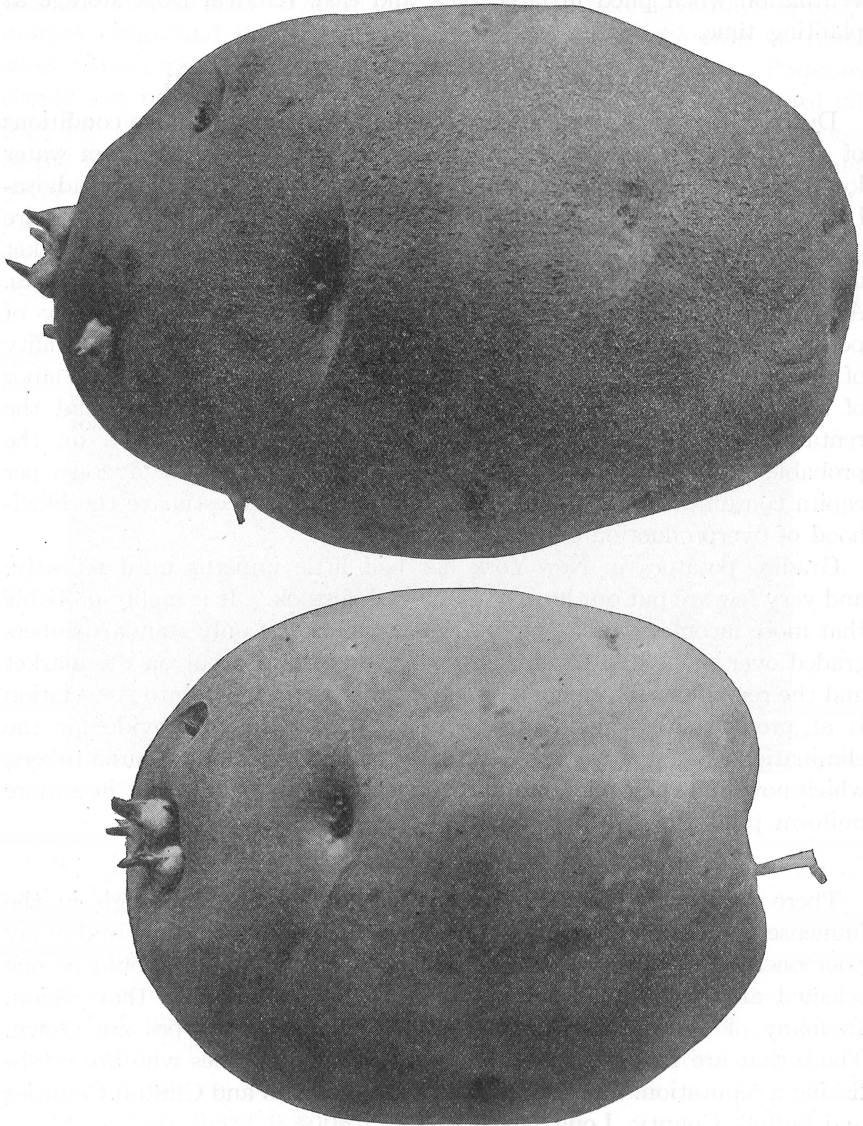


FIG. 73. STANDARD LATE CROP VARIETIES OF POTATOES FOR NEW YORK STATE

Green Mountain above, Rural New Yorker No. 2 below

(7) Burbank, (8) Green Mountain, (9) Rural, (10) Pearl, and (11) Peach-blow. Probably seventy-five per cent of the varieties grown in New

York are of either the Green Mountain or the Rural group. It is generally impossible to distinguish definitely between varieties within the same group, but growers should as far as possible be able to identify one group from another. This would eliminate a large amount of the present mixture of varieties. For example, varieties of the Green Mountain family generally are somewhat elongate oblong in shape, have medium few and medium depth of eyes, somewhat netted skin, and white sprouts. Those of the Rural family are oval flat in shape, have few and shallow eyes with long eye ridges, smooth skin, and sprouts with deep purple or blue tips, leaf scales, and bases. Standard varieties of the Green Mountain family are Green Mountain, State of Maine, Gold Coin, Norcross, White Lady, and Lincoln. Standard varieties of the Rural family include Rural New Yorker No. 2, Carman No. 3, Sir Walter Raleigh, No. 9, Knoxall, and White Giant. Any of the varieties mentioned are desirable for the late crop. The type for each of these groups is shown in figure 73. Both command favor on most markets of the North.

Varieties of the Rural group are somewhat more disease and drought resistant than those of the Green Mountain group. The Rural type predominates in western and southern New York, while Long Island and Franklin and Clinton Counties grow the Green Mountain type almost exclusively. Experience has proved to the growers in these regions that these are the types best adapted to their conditions.

Standard early varieties for New York State are (1) Irish Cobbler, (2) Bliss Triumph, (3) Quick Lunch, (4) Early Ohio, (5) Early Manistee, and (6) Early Rose, ranking in about the order named.

One of the most important steps toward bettering the potato industry is the elimination of many of the existing so-called named varieties and the standardization of a few worthy sorts.

ADVANCED READING

The reading course lessons are designed merely to introduce the subject; they are elementary and brief, and are intended to arouse a desire for more complete knowledge along particular lines. The study of reading course lessons should be introductory to the study of standard agricultural books and of bulletins of the United States Department of Agriculture and the state experiment stations. References for advanced reading may be obtained from the Supervisor of the Reading Course for the Farm, on request. References are given to particular books or bulletins because they are thought to meet particular needs, not because they are considered superior to other publications. The following is a list of references on the subject of this lesson:

The potato. Samuel Fraser. Orange Judd Company, New York City.

The following publications may be obtained as indicated:

Division of Publications, United States Department of Agriculture,
Washington, D. C.

Potato wilt, leaf-roll, and related diseases. U. S. Agr. Dept.
Bulletin 64.

Group classification and varietal descriptions of some American
potatoes. U. S. Agr. Dept. Bulletin 176.

Potato breeding and selection. U. S. Agr. Dept. Bulletin 195.

Potatoes and other root crops as food. Farmers' bulletin 295.

Farm management in northern potato-growing sections. Farm-
ers' bulletin 365.

Good seed potatoes and how to produce them. Farmers'
bulletin 533.

Potato-tuber diseases. Farmers' bulletin 544.

New York Agricultural Experiment Station, Geneva, New York.

Potato fertilizers: method of application and form of nitrogen.
Bulletin 327.

Potato spraying experiments, 1902-1911. Bulletin 349.

New York State College of Agriculture, Ithaca, New York.

Improving the potato crop by selection. Cornell reading course
for the farm, Vol. III, No. 68.

THE CORNELL READING COURSE FOR THE FARM

The College of Agriculture offers to those who desire to learn but are unable to leave their work, a course of reading on the principles and the practices of successful farming. The course is conducted by means of lessons specially prepared for the farmer, known as Cornell Reading Course lessons for the Farm. The lessons discuss practical subjects, and each reader may register for those of particular interest. Direction is given to the reading by the arrangement of the lessons in series and by sending the lessons in each series consecutively. Members of the course also receive new lessons on subjects of general interest as soon as issued, so that the course also provides the latest information available.

On registering for one or more subjects, the reader receives the first lesson on each. The lesson furnishes the text for reading and is accompanied by a supplement called a discussion paper, which is to be returned when the lesson has been studied. On the return of each discussion paper the following lesson in the series is sent. Questions are given on the discussion paper in order to encourage thought and self-expression. Answering the questions is optional, however. It is by returning the discussion papers that the reader may receive the consecutive lessons in each series as often as desired. Requests for agricultural information

may be made on the discussion papers. Questions are referred to specialists for a personal reply.

When the reader has completed a study of the available lessons, he will still continue to receive the new lessons issued on subjects of general interest. Special arrangements may also be made for advanced study. Advanced Reading Courses in Fruit Growing and Vegetable Gardening are conducted by means of a textbook not published by the College, and which is purchased by the reader. References for advanced reading on other subjects will be given on request. The following is a list of the lessons available in each series, corrected to July, 1916. The demand may at any time exhaust the supply of particular numbers.

AVAILABLE READING COURSE LESSONS FOR THE FARM, ARRANGED BY SERIES

Residents of New York State may register for one or more of the series given below by addressing The Cornell Reading Course for the Farm, College of Agriculture, Ithaca, New York.

SERIES	LESSONS
The soil.....	74 Introduction to the principles of soil fertility 42 Tilt and tillage of the soil 50 Nature, effects, and maintenance of humus in the soil 70 Soil moisture and crop production 78 Land drainage and soil efficiency
Poultry.....	80 Incubation 88 Feeding young chickens *353 The interior quality of market eggs
Farm forestry.....	12 The improvement of the woodlot 62 Methods of determining the value of timber in the farm woodlot 28 Recent New York State Laws giving relief from taxation on lands used for forestry purposes 40 County, town, and village forests
The horse.....	46 Feeding and care of the horse 56 Practical horse-breeding 113 Judging draft horses (In press)

*Cornell Agricultural Experiment Station Bulletin. This bulletin is sent with six sets of questions. The answers are graded and returned to the reader.

Dairying.....	86 The production of clean milk
	102 Cooling milk
	82 Cream separation
	32 Composition of milk and some of its products
	60 Farm butter-making
	98 Practical examples in dairy arithmetic
Fruit growing.....	104 Pruning
	84 Insects injurious to the fruit of the apple
	36 Culture of red and black raspberries and of purple-cane varieties
	48 Culture of the cherry
	52 Culture of the blackberry
	72 Culture of the grape
Farm crops.....	24 The rotation of farm crops
	66 Meadows in New York
	90 Alfalfa for New York
	108 Culture of sweet clover and vetch
	110 Buckwheat
	112 Potato growing in New York
Vegetable gardening.....	58 Planting the home vegetable garden
	†33 Vegetable gardening
	†83 Raising vegetables for canning
	92 Summer care of the home vegetable garden
Plant breeding.....	38 Principles and methods of plant-breeding
	44 Methods of breeding oats
	68 Improving the potato crop by selection
Flower growing.....	106 Spring in the flower garden
	†35 The flower garden
Country life.....	64 The rural school and the community
	76 Birds in their relation to agriculture in New York State
	94 The farm fishpond
	96 The surroundings of the farm home

†Lesson for the Farm Home.